Non-CO_2 Greenhouse Gases: High-GWP Gases

Source/Sectors: Substitution of ODS/Cold Storage Warehouse

Technology: HFC secondary loop systems (C.1.1.6.4)

Description of the Technology:
Better equipment design and store layout can lead to a reduction in the amount of refrigerant needed for a given amount of product cooling, hence reduce emissions of HFCs. Secondary loop systems segregate refrigerant-containing equipment to a separate and centralized location, and use a benign fluid to transfer heat from the food display cases. Thus, by centralizing refrigerants to one or a few locations, the technology allows systems to have lower leak rates and operate at reduced charges (IEA, 2003; USEPA, 2006b). It also allows economical installation of leak-detection equipment to alert system operators when HFC refrigerant emissions occur (US Climate Change, 2005).

The system has great benefits in that it requires less maintenance, has more efficient defrost, and longer shelf life than direct expansion, the conventional systems (IEA, 2003; USEPA, 2001).

Effectiveness: Good

Implementability: Applicable to all regions; easy to operate and maintain (IEA, 2003)

Reliability: Good

Maturity: Well developed technologically

Environmental Benefits: HFCs emission reduction

Cost Effectiveness:

Technology	Lifetime (yrs)	MP (%)	RE (%)	TA (%)	Capital cost	Annual cost	Benefits
HFC secondary loop systems[1]	20	10-20	100	11-31	$30.93	$12.89	$1.58

Note: MP: market penetration; RE: reduction efficiency; TA: technical applicability; costs are in year 2000 US$/$MT_{CO2\text{-}Eq.}$
1: IEA (2003) & USEPA (2001)

Industry Acceptance Level: EPA has carried out a test for this system; various manufacturers are also conducting their own proprietary research. Its potential market penetration is high, for this technical option can be introduced to newly constructed storages and/or retrofitted storages (US Climate Change, 2005; USEPA, 2001).

Limitations: The system is especially effective for low-temperature (e.g., frozen foods) systems; however, the number of these systems is very limited.

Sources of Information:

1. California Energy Commission (2005) "Emission Reduction Opportunities for Non-CO_2 Greenhouse Gases in California", a report prepared by ICF Consulting for California Energy Commissions, CEC-500-2005-121, July 2005.

2. International Energy Agency (2001) “Abatement of Emissions of Other Greenhouse Gases - Engineered Chemicals”, Report Number PH3/35, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, February 2001.
3. International Energy Agency (2003) “Building the Cost Curves for the Industrial Sources of Non-CO_2 Greenhouse Gases”, Report Number PH4/25, IEA Greenhouse Gas R&D Programme, Cheltenham, United Kingdom, October 2003.
4. Kruse, H. (1996) “The State of the Art of Hydrocarbon Technology in Household Refrigeration”, *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
5. Mathur, G.D. (1996) “Performance of Vapor Compression Refrigeration System with Hydrocarbons: Propane, Isobutane, and 50/50 Mixture of Propane/isobutane”, *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
6. Paul, J. (1996) “A Fresh Look at Hydrocarbon Refrigeration: Experience and Outlook”, *Proc. International Conference on Ozone Protection Technologies*, October 21-23, Washington, D.C.
7. Sand, J.R.; Fischer, S.K.; Baxter, V.D. (1997) “Energy and Global Warming Impacts of HFC Refrigerants and Emerging Technologies”. Prepared by Oak Ridge National Laboratory for Alternative Fluorocarbons Environmental Acceptability Study and U.S. Department of Energy, Oak Ridge, TN.
8. U.S. Climate Change Technology Program (2005) “Technology Options for the Near and Long Term”, U.S. Department of Energy, http://www.climatetechnology.gov/index.htm, August 2005.
9. U.S. Environmental Protection Agency (2001) “U.S. High GWP Gas Emissions 1990 – 2010: Inventories, Projections, and Opportunities”, Office of Air and Radiation, U.S. Environmental Protection Agency, EPA 000-F-97-000, June 2001.
10. U.S. Environmental Protection Agency (2004) “Analysis of Cost to Abate Ozone-depleting Substitute Emissions”, Office of Air and Radiation, U.S. Environmental Protection Agency, EPA 430-R-04-006, June 2004.
11. U.S. Environmental Protection Agency (2006a) “Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 to 2004” Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-002, June 2006
12. U.S. Environmental Protection Agency (2006b) “Global Mitigation of Non-CO_2 Greenhouse Gases”, Office of Atmospheric Programs, United States Environmental Protection Agency, EPA-430-R-06-005, June 2006.
13. UNEP - United Nations Environment Programme (1998) “Report of the Refrigeration, Air Conditioning and Heat Pumps”, Technical Options Committee; Nairobi, December 1998.
14. van Gerwen, R.; Vervoerd, M. (2000) “Emission reduction of non-CO_2 Greenhouse Gases Used as Refrigerants” in Non-CO_2 Greenhouse Gases: Scientific Understanding, Control and Implementation (edited by J. Van Ham *et al.*), Kluwer Academic Publishers, London.
15. Walker, D. (2000) “Low-charge Refrigeration for Supermarkets”, IEA Heat Pump Center Newsletter, vol. 18, no. 1, p. 13-16.